General

Guideline Title

Spinal cord injury without radiographic abnormality (SCIWORA). In: Guidelines for the management of acute cervical spine and spinal cord injuries.

Bibliographic Source(s)

Rozzelle CJ, Aarabi B, Dhall SS, Gelb DE, Hurlbert RJ, Ryken TC, Theodore N, Walters BC, Hadley MN. Spinal cord injury without radiographic abnormality (SCIWORA). In: Guidelines for the management of acute cervical spine and spinal cord injuries. Neurosurgery. 2013 Mar;72(Suppl 2):227-33. [27 references] PubMed

Guideline Status

This is the current release of the guideline.

Recommendations

Major Recommendations

The rating schemes used for the strength of the evidence (Class I-III) and the levels of recommendations (Level I-III) are defined at the end of the "Major Recommendations" field.

Recommendations

Diagnosis

Level III

- Magnetic resonance imaging (MRI) of the region of suspected neurological injury is recommended in a patient with spinal cord injury without radiographic abnormality (SCIWORA).
- Radiographic screening of the entire spinal column is recommended.
- Assessment of spinal stability in a SCIWORA patient is recommended with flexion-extension radiographs in the acute setting and at late follow-up, even in the presence of an MRI negative for extraneural injury.
- Neither spinal angiography nor myelography is recommended in the evaluation of patients with SCIWORA.

Treatment

Level III

- External immobilization of the spinal segment of injury is recommended for up to 12 weeks.
- Early discontinuation of external immobilization is recommended for patients who become asymptomatic and in whom spinal stability is

confirmed with flexion and extension radiographs.
- Avoidance of "high-risk" activities for up to 6 months following SCIWORA is recommended.

Summary

SCIWORA is a widely recognized form of spinal cord injury, occurring almost exclusively in children, and is characterized by the absence of any radiographically evident fracture, dislocation, or malalignment. Children presenting with a history of transient neurological signs or symptoms referable to the spinal cord after a traumatic event, despite the absence of objective neurological deficits with normal radiographs, may develop SCIWORA in a delayed fashion.

No child with SCIWORA has developed pathological intersegmental motion with instability when early flexion and extension radiographs have been normal.

MRI has not identified any abnormal findings in a child with SCIWORA when the management scheme would be changed by the results of the MRI. Similarly, no child with SCIWORA in whom a subsequent MRI has documented ligamentous injury has developed evidence of spinal instability.

Treatment consisting of cervico-thoracic bracing for patients with cervical-level SCIWORA for 12 weeks and avoidance of activities that encourage flexion and extension of the neck for an additional 12 weeks has not been associated with recurrent injury. Patients with normal MRI and somatosensory evoked potential (SSEP) findings following transient deficits or "symptoms only" may be managed with a cervical collar for 1 to 2 weeks.

The spinal cord findings on MRI provide prognostic information regarding long-term neurological outcome in patients with SCIWORA. Myelography and angiography have no defined role in the evaluation of children with SCIWORA.

Definitions:

Rating Scheme for the Strength of the Evidence: Modified North American Spine Society Schema to Conform to Neurosurgical Criteria as Previously Published and for Ease of Understanding and Implementation: Levels of Evidence for Primary Research Question[a]

Class	Therapeutic Studies: Investigating the Results of Treatment	Diagnostic Studies: Investigating a Diagnostic Test	Clinical Assessment: Studies of Reliability and Validity of Observations, Including Clinical Examination, Imaging Results, and Classifications
I	High-quality randomized controlled trial with statistically significant difference or no statistically significant difference but narrow confidence intervals	Testing of previously developed diagnostic criteria on consecutive patients (with universally applied reference "gold" standard)	Evidence provided by 1 or more well-designed clinical studies in which interobserver and intraobserver reliability is represented by a Ä, statistic ≥0.60 or an intraclass correlation coefficient of ≥0.70
	Systematic review[b] of Class I randomized controlled trials (and study results were homogeneous[c])	Systematic review[b] of Class I studies	
II	Lesser-quality randomized controlled trial (e.g., <80% follow-up, no blinding, or improper randomization)	Development of diagnostic criteria on consecutive patients (with universally applied reference "gold" standard)	Evidence provided by 1 or more well-designed clinical studies in which interobserver and intraobserver reliability is represented by a Ä, statistic of 0.40–0.60 or an intraclass correlation coefficient of 0.50–0.70
	Prospective[d] comparative study[e]	Systematic review[b] of Class II studies	
	Systematic review[b] of Class II studies or Class I studies with inconsistent results	Study of nonconsecutive patients; without consistently applied reference "gold" standard	
	Case-control study[g]	Systematic review[b] of Class III studies	
	Retrospective[f] comparative study[e]	Case-control study	
	Systematic review[b] of Class II studies		
III	Case series[h]	Poor reference standard	Evidence provided by 1 or more well-designed clinical

Class	Therapeutic Studies: Investigating the Results of Treatment	Diagnostic Studies: Investigating a Diagnostic Test	Clinical Assessment: Studies of Reliability and Validity of Observations, Including Clinical Examination, Imaging Results, and Classifications
	Expert opinion	Expert opinion	studies in which interobserver and intraobserver reliability is represented by a κ statistic of <0.40 or an intraclass correlation coefficient of <0.50

[a]A complete assessment of quality of individual studies requires critical appraisal of all aspects of the study design.

[b]A combination of results from 2 or more prior studies.

[c]Studies provided consistent results.

[d]Study was started before the first patient enrolled.

[e]Patients treated 1 way (e.g., halo vest orthosis) compared with a group of patients treated in another way (e.g., internal fixation) at the same institution.

[f]The study was started after the first patient was enrolled.

[g]Patients identified for the study on the basis of their outcome, called "cases" (e.g., failed fusion), are compared with those who did not have outcome, called "controls" (e.g., successful fusion).

[h]Patients treated 1 way with no comparison group of patients treated in another way.

Levels of Recommendation

Level I	Generally accepted principles for patient management, which reflect a high degree of clinical certainty (usually this requires Class I evidence which directly addresses the clinical questions or overwhelming Class II evidence when circumstances preclude randomized clinical trials)
Level II	Recommendations for patient management which reflect moderate clinical certainty (usually this requires Class II evidence or a strong consensus of Class III evidence)
Level III	Other strategies for patient management for which the clinical utility is uncertain (inconclusive or conflicting evidence or opinion)

Clinical Algorithm(s)

None provided

Scope

Disease/Condition(s)

Spinal cord injury without radiographic abnormality (SCIWORA)

Guideline Category

Diagnosis

Evaluation

Management

Treatment

Clinical Specialty

Nephrology

Neurological Surgery

Orthopedic Surgery

Pediatrics

Radiology

Intended Users

Advanced Practice Nurses

Hospitals

Nurses

Physician Assistants

Physicians

Guideline Objective(s)

To provide a contemporary analysis of the literature on the diagnosis and treatment of spinal cord injury without radiographic abnormality (SCIWORA) since the original publication

Target Population

Children and adolescents presenting with a history of transient neurological signs or symptoms referable to the spinal cord after a traumatic event, despite the absence of objective neurological deficits with normal radiographs

Interventions and Practices Considered

Diagnosis/Evaluation

1. Magnetic resonance imaging (MRI) of the region of suspected neurological injury
2. Radiographic screening of the entire spinal column
3. Assessment of spinal stability with flexion-extension radiographs in the acute setting and at late follow-up

Treatment/Management

1. External immobilization of the spinal segment of injury
2. Early discontinuation of external immobilization in patients who become asymptomatic and in whom spinal stability is confirmed with flexion and extension radiographs
3. Avoidance of "high-risk" activities for up to 6 months

Note: Spinal angiography and myelography were considered but not recommended.

Major Outcomes Considered

- Diagnostic and prognostic value of magnetic resonance imaging (MRI) in spinal cord injury without radiographic abnormality (SCIWORA)
- Incidence of SCIWORA
- Recurrence of SCIWORA

Methodology

Methods Used to Collect/Select the Evidence

Hand-searches of Published Literature (Primary Sources)

Hand-searches of Published Literature (Secondary Sources)

Searches of Electronic Databases

Description of Methods Used to Collect/Select the Evidence

Search Criteria

A National Library of Medicine (PubMed) computerized literature search from 1966 to 2011 was undertaken using Medical Subject Headings in combination with "spinal cord injury": "pediatric," "spinal cord concussion," "cervical cord neurapraxia," and "SCIWORA." Approximately 188 citations were acquired. Non-English language citations were deleted. Articles written in English were reviewed for those that identified children who incurred a SCIWORA. Those articles that described the clinical aspects and management of children with SCIWORA were used to generate these guidelines. Case reports were excluded from review. Of the 19 articles meeting selection criteria, none provided Class I or Class II medical evidence. All were case series representing Class III medical evidence.

Number of Source Documents

Summaries of 19 articles are provided in Evidentiary Table format (see Table 1 in the original guideline document).

Methods Used to Assess the Quality and Strength of the Evidence

Weighting According to a Rating Scheme (Scheme Given)

Rating Scheme for the Strength of the Evidence

Rating Scheme for the Strength of the Evidence: Modified North American Spine Society Schema to Conform to Neurosurgical Criteria as Previously Published and for Ease of Understanding and Implementation: Levels of Evidence for Primary Research Question[a]

Class	Therapeutic Studies: Investigating the Results of Treatment	Diagnostic Studies: Investigating a Diagnostic Test	Clinical Assessment: Studies of Reliability and Validity of Observations, Including Clinical Examination, Imaging Results, and Classifications
I	High-quality randomized controlled trial with statistically significant difference or no statistically significant difference but narrow confidence intervals	Testing of previously developed diagnostic criteria on consecutive patients (with universally applied reference "gold" standard)	Evidence provided by 1 or more well-designed clinical studies in which interobserver and intraobserver reliability is represented by a Ä, statistic ≥0.60 or an intraclass correlation coefficient of ≥0.70
	Systematic review[b] of Class I randomized controlled trials (and study results were homogeneous[c])	Systematic review[b] of Class I studies	
II	Lesser-quality randomized controlled trial (e.g., <80% follow-up, no blinding, or improper randomization)	Development of diagnostic criteria on consecutive patients (with universally applied reference "gold" standard)	Evidence provided by 1 or more well-designed clinical studies in which interobserver and intraobserver reliability is represented by a Ä, statistic of 0.40–0.60 or an intraclass correlation coefficient of 0.50–0.70
	Prospective[d] comparative study[e]	Systematic review[b] of Class II studies	
	Systematic review[b] of Class II studies or Class I studies with inconsistent results	Study of nonconsecutive patients; without consistently applied reference "gold" standard	

Class	Therapeutic Studies: Investigating the Results of Treatment	Diagnostic Studies: Investigating a Diagnostic Test	Clinical Assessment: Studies of Reliability and Validity of Observations, Including Clinical Examination, Imaging Results, and Classifications
	Case-control study[g]	Systematic review[b] of Class III studies	
	Retrospective[f] comparative study[e]	Case-control study	
	Systematic review[b] of Class II studies		
III	Case series[h]	Poor reference standard	Evidence provided by 1 or more well-designed clinical studies in which interobserver and intraobserver reliability is represented by a Ä, statistic of <0.40 or an intraclass correlation coefficient of <0.50
	Expert opinion	Expert opinion	

[a]A complete assessment of quality of individual studies requires critical appraisal of all aspects of the study design.

[b]A combination of results from 2 or more prior studies.

[c]Studies provided consistent results.

[d]Study was started before the first patient enrolled.

[e]Patients treated 1 way (e.g., halo vest orthosis) compared with a group of patients treated in another way (e.g., internal fixation) at the same institution.

[f]The study was started after the first patient was enrolled.

[g]Patients identified for the study on the basis of their outcome, called "cases" (e.g., failed fusion), are compared with those who did not have outcome, called "controls" (e.g., successful fusion).

[h]Patients treated 1 way with no comparison group of patients treated in another way.

Methods Used to Analyze the Evidence

Systematic Review with Evidence Tables

Description of the Methods Used to Analyze the Evidence

Selected articles were carefully reviewed by the authors. An evidentiary table was created (refer to Table 1 in the original guideline document) that reflected the strengths and weaknesses of each article.

On occasion, the assessed quality of the study design was so contentious and the conclusions so uncertain that the guideline authors assigned a lower medical evidence classification than might have been expected without such a detailed review. In every way, adherence to the Institute of Medicine's criteria for searching, assembling, evaluating, and weighing the available medical evidence and linking it to the strength of the recommendations presented in this document was carried out.

Articles that did not achieve immediate consensus among the author group were discussed extensively until a consensus was reached. Very few contributions required extensive discussion. Most articles were easily designated as containing Class I, II, or III medical evidence using the criteria set forth by the author group at the initiation of the literature evaluation process (see the "Rating Scheme for the Strength of the Evidence" field).

Methods Used to Formulate the Recommendations

Expert Consensus

Description of Methods Used to Formulate the Recommendations

The current author group was selected for its expertise in spinal surgery (both neurosurgical and orthopedic), neurotrauma, clinical epidemiology, and, in several cases, prior experience with guideline development. The topics chosen for inclusion in this iteration of these guidelines are contemporary and pertinent to the assessment, evaluation, care, and treatment of patients with acute cervical spine and/or spinal cord injuries.

Rating Scheme for the Strength of the Recommendations

Levels of Recommendation

Level I	Generally accepted principles for patient management, which reflect a high degree of clinical certainty (usually this requires Class I evidence which directly addresses the clinical questions or overwhelming Class II evidence when circumstances preclude randomized clinical trials)
Level II	Recommendations for patient management which reflect moderate clinical certainty (usually this requires Class II evidence or a strong consensus of Class III evidence)
Level III	Other strategies for patient management for which the clinical utility is uncertain (inconclusive or conflicting evidence or opinion)

Cost Analysis

A formal cost analysis was not performed and published cost analyses were not reviewed.

Method of Guideline Validation

Not stated

Description of Method of Guideline Validation

Not applicable

Evidence Supporting the Recommendations

Type of Evidence Supporting the Recommendations

The type of supporting evidence is identified and graded for each recommendation (see the "Major Recommendations" field). All articles were case series representing Class III medical evidence.

Benefits/Harms of Implementing the Guideline Recommendations

Potential Benefits

Accurate diagnosis and appropriate treatment of spinal cord injury without radiographic abnormality (SCIWORA) with improved neurological outcome

Potential Harms

Not stated

Qualifying Statements

Qualifying Statements

- Medical evidence-based guidelines are not meant to be restrictive or to limit a clinician's practice. They chronicle multiple successful treatment options (for example) and stratify the more successful and the less successful strategies based on scientific merit. They are not absolute, "must be followed" rules. This process may identify the most valid and reliable imaging strategy for a given injury, for example, but because of regional or institutional resources, or patient co-morbidity, that particular imaging strategy may not be possible for a patient with that injury. Alternative acceptable imaging options may be more practical or applicable in this hypothetical circumstance.
- Guidelines documents are not tools to be used by external agencies to measure or control the care provided by clinicians. They are not medical-legal instruments or a "set of certainties" that must be followed in the assessment or treatment of the individual pathology in the individual patients we treat. While a powerful and comprehensive resource tool, guidelines and the recommendations contained therein do not necessarily represent "the answer" for the medical and surgical dilemmas faced with many patients.

Implementation of the Guideline

Description of Implementation Strategy

An implementation strategy was not provided.

Implementation Tools

Mobile Device Resources

For information about availability, see the *Availability of Companion Documents* and *Patient Resources* fields below.

Institute of Medicine (IOM) National Healthcare Quality Report Categories

IOM Care Need

Getting Better

IOM Domain

Effectiveness

Identifying Information and Availability

Bibliographic Source(s)

Rozzelle CJ, Aarabi B, Dhall SS, Gelb DE, Hurlbert RJ, Ryken TC, Theodore N, Walters BC, Hadley MN. Spinal cord injury without radiographic abnormality (SCIWORA). In: Guidelines for the management of acute cervical spine and spinal cord injuries. Neurosurgery. 2013 Mar;72(Suppl 2):227-33. [27 references] PubMed

Adaptation

Not applicable: The guideline was not adapted from another source.

Date Released

2013 Mar

Guideline Developer(s)

American Association of Neurological Surgeons - Medical Specialty Society

Congress of Neurological Surgeons - Professional Association

Source(s) of Funding

Congress of Neurological Surgeons

Guideline Committee

Guidelines Author Group of the Joint Section of Disorders of the Spine and Peripheral Nerves of the American Association of Neurological Surgeons and the Congress of Neurological Surgeons

Composition of Group That Authored the Guideline

Authors: Curtis J. Rozzelle, MD, Division of Neurological Surgery, Children's Hospital of Alabama, University of Alabama at Birmingham, Birmingham, Alabama; Bizhan Aarabi, MD, FRCSC, Department of Neurosurgery, University of Maryland, Baltimore, Maryland; Sanjay S. Dhall, MD, Department of Neurosurgery, Emory University, Atlanta, Georgia; Daniel E. Gelb, MD, Department of Orthopaedics, University of Maryland, Baltimore, Maryland; R. John Hurlbert, MD, PhD, FRCSC, Department of Clinical Neurosciences, University of Calgary Spine Program, Faculty of Medicine, University of Calgary, Calgary, Alberta, Canada; Timothy C. Ryken, MD, MS, Iowa Spine & Brain Institute, University of Iowa, Waterloo/Iowa City, Iowa; Nicholas Theodore, MD, Division of Neurological Surgery, Barrow Neurological Institute, Phoenix, Arizona; Beverly C. Walters, MD, MSc, FRCSC (*Lead Author*), Division of Neurological Surgery, University of Alabama at Birmingham, Birmingham, Alabama, Department of Neurosciences, Inova Health System, Falls Church, Virginia; Mark N. Hadley, MD (*Lead Author*), Division of Neurological Surgery, University of Alabama at Birmingham, Birmingham, Alabama

Financial Disclosures/Conflicts of Interest

The authors have no personal financial or institutional interest in any of the drugs, materials, or devices described in this guideline.

Guideline Status

This is the current release of the guideline.

Guideline Availability

Electronic copies: Available in Portable Document Format (PDF) and EPUB for eBook devices from the Neurosurgery Web site .

Availability of Companion Documents

The following are available:

- Foreword. Guidelines for the management of acute cervical spine and spinal cord injuries. Neurosurgery 2013;72(3):1. Electronic copies: Available in Portable Document Format (PDF) from the Neurosurgery Web site .

- Commentary. Guidelines for the management of acute cervical spine and spinal cord injuries. Neurosurgery 2013;72(3):2-3. Electronic copies: Available in PDF from the Neurosurgery Web site .
- Introduction to the guidelines for the management of acute cervical spine and spinal cord injuries. Neurosurgery 2013;72(3):5-16. Electronic copies: Available in PDF from the Neurosurgery Web site .
- Methodology of the guidelines for management of acute cervical spine and spinal cord injuries. Neurosurgery 2013;72(3):17-21. Electronic copies: Available in PDF from the Neurosurgery Web site .

Patient Resources

None available

NGC Status

This NGC summary was completed by ECRI Institute on July 9, 2013. The information was verified by the guideline developer on October 3, 2013.

Copyright Statement

Disclaimer

NGC Disclaimer